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THE

Connecticut Agricultural Experiment Station,

NEW HAVEN, CONN.

BULLETIN No. 102.

MARCH, 1890.

The Bulletins and Reports of this Station are mailed free to every citizen of Connecticut who applies for them.

FUNGICIDES.

By Roland Thaxter, Mycologist.

This Bulletin is designed to call the attention of farmers to the importance of gaining some practical knowledge of the use of fungicides and to furnish brief directions for this purpose. More detailed information on the subject, adapted to special diseases, will be furnished by the Station on application; and, when practicable, personal attention will be given in such cases if desired.

The advantage resulting from the application of fungicides has been so thoroughly and repeatedly demonstrated in connection with black rot and mildews of the grape, that their use may be recommended without reservation in these cases. The same may be said of numerous other similar diseases upon which experiments have been tried, or which, from the known life-history of the fungus producing them, may be safely assumed to be susceptible to a like treatment. In view of the fact, however, that the use of fungicides is an innovation in the agriculture of this State,

the Station would not recommend any one who has had no previous experience in the matter to make use of them on a large scale at first; but to test their effectiveness for himself, by a smaller and carefully conducted preliminary experiment; so that, by making a direct comparison between the results of treatment and no treatment, he may form his opinion as to the value of the application from personal experience.

It is hardly necessary to remark that it is of the first importance to know definitely, before making any such trial, what disease is to be treated, and application to the Station for information on the subject is advised: since a confusion in the mind of the experimenter between two somewhat similar diseases, like the black rot and anthracnose of the grape, might lead to a mere waste of labor and material in carrying out the treatment. It should be remembered also that the application, to be effectual, must, in the majority of cases, be made for the purpose of prevention, not of cure; so that everything necessary for the purpose should be ready by the first of May or earlier. The publications of the U. S. Department of Vegetable Pathology, which may be obtained on application to the Department of Agriculture at Washington, and contain much valuable information on the subject, should also be consulted in this connection.

Of the somewhat considerable number of substances which have been used as fungicides the two which may be most safely recommended for general use are the Bordeaux Mixture and the Ammoniacal Carbonate of Copper Solution, the formulas for which are as follows:

BORDEAUX MIXTURE.

Sulphate of copper (blue vitriol, blue stone)	6 lbs.
Quick lime	4 lbs.
Water	22 gals.

Dissolve the sulphate of copper in two gallons of hot water to hasten the solution, which is also facilitated if the sulphate is pulverized. Dilute this solution with fourteen gallons of water. Slake the lime, *which must be fresh* (i. e. not partly air slaked), slowly, with six gallons of water, stirring the mixture while so doing to a smooth paste. After this is slightly cooled, pour it slowly into the copper solution, stirring the whole rapidly at the same time.

For use this mixture must be stirred and strained through fine brass or copper gauze. A small piece of the latter, tacked over

the bottom of a salt or strawberry box, is sufficient for the purpose, and the straining is easily and rapidly done if the mixture is poured slowly upon the gauze from a slight elevation (two or three feet), which avoids clogging the meshes of the strainer. Mixing, etc., should be done in wooden vessels, since the substances corrode iron or tin.

Ammoniacal Carbonate of Copper.

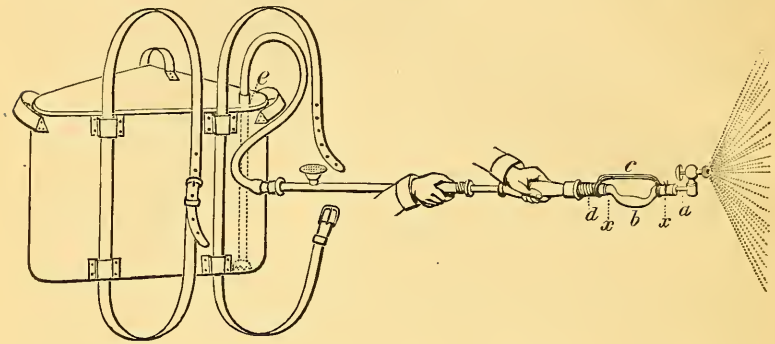
Carbonate of copper	3 oz.
Commercial ammonia (22°)	1 qt.
Water	22 gals.

Add the ammonia to the carbonate and when dissolved dilute to twenty-two gallons with water, forming a clear solution.

If these substances are properly prepared there need be no fear of any injury to the foliage resulting from their application. The Bordeaux mixture when applied to vineyards has, however, the disadvantage of frequently injuring the fruit by adhering to the berries at the time of harvest. Mr. Galloway has suggested that this may be avoided by using the carbonate of copper for the last or the last two applications; since it is free from this objection. A practical method of removing the Bordeaux Mixture from the clusters has also been tried by Dr. Neale at the Delaware Experiment Station by treating the injured clusters with highly diluted vinegar, two quarts of vinegar to ten gallons of water. By immersing the clusters in this solution for a few moments and rinsing twice in clear water the stains were effectually removed without appreciable injury to the bloom of the clusters, at a total expense of fifty cents per thousand pounds.

Apparatus for Spraying.—The first requisite for the purpose is a force pump of some sort, of which the inner fittings, at least must be of brass, to avoid rapid corrosion by the substances sprayed. For spraying, when it is to be done by one man without assistance, a good machine, which combines a proper force pump with a supply of the material used, is the "Eureka" Sprayer manufactured by Adam Weaber & Son, Vineland, N. J., the reservoir of which, made of copper and furnished with a strainer, is carried, knapsack fashion, on the back, and contains a pump furnished with a large air chamber which ensures a perfectly steady stream. The pump is worked with the least possible labor by means of a lever held in the right hand, while the left carries a rod which directs the stream from the nozzle at its end. The chief objection

to this machine is its expense ($20.60 and freight), and to obviate this the cheaper apparatus figured below, has been devised and has been used with satisfaction during the past season. This consists of an ordinary copper wash boiler of the smallest size and a force pump of the "hydronette" or "aquanette" pattern. A piece not quite large enough to admit the hose of the hydronette is cut



out from the edge of the boiler cover at *e*, and a short collar of tin soldered into it with a slot broad enough to allow the hose to be pushed into it sideways. (This socket is misdrawn in the cut, the broken rim of the cover not being connected vertically with edges of the collar as they should be.) The hose when pushed into the socket therefore projects just enough to be firmly held against the side of the boiler when the cover is shut down. A couple of wire catches may be necessary to hold the cover on firmly, if it is not very tight; and in addition the boiler should be fitted with straps as in the cut, or in any other convenient manner so that it can be carried on the back of the operator.

Since pumps of the "hydronette" pattern do not throw a steady stream, acting only when the piston is driven back, some appliance is necessary to produce an even, continuous spray. This is very readily provided as shown by the cut. A piece of $\frac{5}{8}$-inch heavy but elastic rubber "*tubing*" (*b*)—hose will not answer—is fastened to a "Vermorel" nozzle (*a*) at one end (*x*) and to the hydronette nozzle (*d*) at the other end (*x*), by winding it tightly with a few inches of small copper wire. The two nozzles *a* and *d* are then connected by two heavy copper wires (*c*) fastened by winding once or twice around each nozzle. The Vermorel nozzle is thus held firmly in place, and, as the wire will stand any amount of bending, the direction of the stream is easily regulated in this way. The

length of the copper wire and rubber tubing may be increased as desired; for spraying the under side of the leaves of low shrubs, for instance, the wire being bent so as to send a vertical stream; but six inches of tubing is about as short a length as will furnish sufficient elasticity for producing a steady stream. The pump may be also used for spraying trees by using the necessary length of small hose furnished with a spray nozzle at one end, and connected at the other with a piece of rubber tubing long enough to allow free motion to the piston. The hose can then be fastened to a light pole and the body of the pump so fastened to its base as to allow free movement of the piston.

The apparatus can of course be used without the copper boiler, by carrying the substance to be sprayed in a pail or other vessel; but when liquids are used, such as the Bordeaux mixture or Paris green in water, which have to be kept stirred while being used, the boiler gives far less trouble, since the motion of the body keeps its contents stirred up while in use. The apparatus has this additional advantage that, by procuring an extra hydronette nozzle or a coupling which will serve to attach the sprayer as described, the spray nozzle and its adjuncts may be screwed off as a whole when not in use, and the ordinary nozzle substituted; so that the pump may be also employed for any of the many purposes for which it is useful. The cost of this apparatus, not including straps or strainer, is about as follows:

Copper boiler (No. 7)	$3.25
Hydronette pump	4.00
Wire and rubber tubing	.20
Fittings to boiler	1.00
Vermorel nozzle	1.25
Total	$9.80

For spraying on a larger scale a stationary pump is needed, and by far the best for the purpose is a double-acting force pump such as "Gould's Double-acting Spraying Pump" (made by the Gould Mfg. Co., Seneca Falls, N. Y.), or any similarly constructed pump. This is made to screw on a barrel or hogshead which may be carried in a wheelbarrow or cart. The pump is furnished with two couplings, one on either side, which may be both fitted with light spraying hose. By coupling a short hose to one, and turning it back into the barrel, the trouble of stirring the mixture (when this is necessary) is obviated, if a single

spraying hose only is needed. The stirring, however, is readily done by the man who pumps, by means of a short paddle, fastened into the hogshead by a leather thong.

If an orchard is to be treated it can be very rapidly done by driving the cart containing the mixture and pump between the rows and running a sprayer on either side. By using light hose, such as can be got for 14 cts. a foot, and fastening the sprayer in a convenient position to the end of a light pole of the necessary length, to which the hose is also attached for part of its length, the treatment of large trees is accomplished with great ease and rapidity.

It is of great importance to have a proper nozzle for spraying, and if the mixture is not a clear fluid, the "Vermorel" nozzle is well suited for the purpose; being self-cleaning and producing an abundant and almost perfect spray.* For clear fluids the Nixon nozzle made by the Nixon Nozzle and Machine Co., Dayton, Ohio, is excellent; and gives a very fine, direct spray.

In the treatment of fungus diseases no general directions can be given which will apply in all cases, and information on the subject should be previously obtained from some reliable source. In general, however, it may be said that treatment should in the majority of cases be preventive rather than curative, the application being effective only when made before the disease has appeared. An application of a strong fungicide to vines or trees during late winter or early spring is often useful by killing fungus spores adhering to them. For this purpose a Bordeaux mixture made as above described, by using ten pounds of sulphate of copper, ten pounds of lime and twenty-five gallons of water, may be employed; and a strong (25 per cent.) solution of sulphate of iron has been found of advantage for the same purpose.

The apparatus just described for the application of fungicides is equally well adapted to the use of insecticides. If Paris green or London purple are to be used, they may in some cases be mixed with the fungicide solution in the usual proportions when a double treatment is esired.

* A limited number of these nozzles will be furnished on application to the Station at the wholesale price ($1.25 and postage, 5 cents).

The following quotations on materials needed for the purpose of preparing and applying fungicides have been kindly furnished by the firms named.

Sulphate of Copper in original package of 400 lbs., per lb.	.06½
" in lots of 100 lbs., per lb.	.07½
" per pound in small amounts	.10
Ammonia (26°) in Carboy of 80 lbs. (For use dilute with one-third its volume of water giving 22°), per lb.	.08
" in small quantities, without package, per lb.	.10
Carbonate of Copper, per lb.	.75

C. B. Whittlesey & Co., State St., New Haven.

⅝-inch heavy rubber tubing, per foot	.18

Conant Rubber Co., 26 Asylum St., Hartford.

Copper wash boilers, No. 7	3.25

G. W. Hazel, 11 Church St., New Haven.

Aquanette force pump	4.00

T. W. Corbett, 280 Elm St., New Haven.

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